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FV
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test pixel

LUT
122

memory 120

Fig. 1

1a 2a	1b 2b	1c 2c
1d 2d	1e test pixel 2e	1f 2f
1g 2g	1h 2h	1i 2i

Fig. 2

n E	times added	times subtracted	times right-shifted
1	1	0	1
2	2	0	2
3	1	0	2
4	4	0	3
5	3	0	3
6	2	0	3
7	1	0	3
8	1	1	3

LUT

122

Fig. 3

```
if(De-ringing filter) //De-ringing filter decision made by decision stage
{
nE=0;
newVal=0;

  for(ix=-1;ix<=1;ix++)
    for(iy=-1;iy<=1;iy++)
      {
          if( Map (i + ix, j + iy) ==0)
          {
                  if((ix!=0) | |(iy!=0))
                  {
                          newVal = newVal + I (i + ix, j + iy);
                          nE++;
                  }
          }
      }

if(nE==1)
{
        I(i, j) =(( newVal + I(i, j) + 1)>>1);

}
 else if(nE<4)
{
        for(ii=nE;ii<4;ii++)
        {
                newVal = newVal + I(i, j);
        }
        I(i, j) =(( newVal +2)>>2);

}
 else if(nE<8)
 {
        for(ii=nE;ii<8;ii++)
        {
                newVal = newVal+ I(i, j);
        }
        I(i, j) =((rAvg+4)>>3);

}
else if(nE==8)
 {
        I(i, j) =(( newVal- I (i +1, j +1) + I(i, j) +4)>>3);

}

}
```
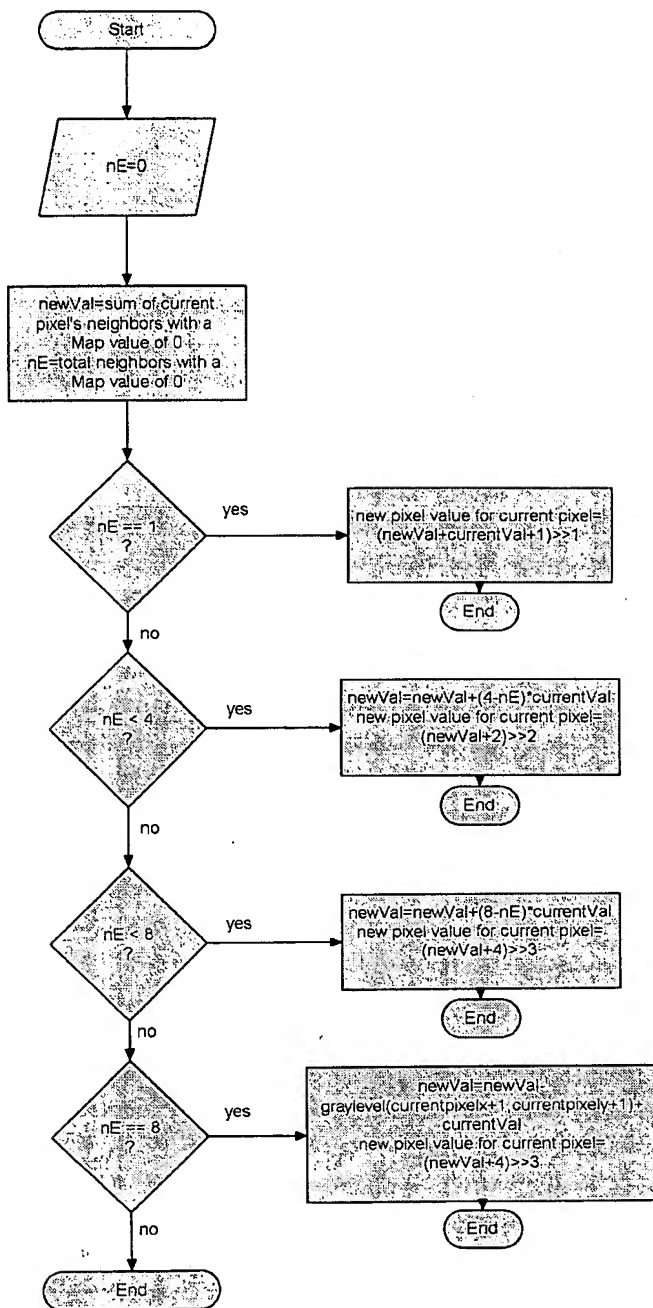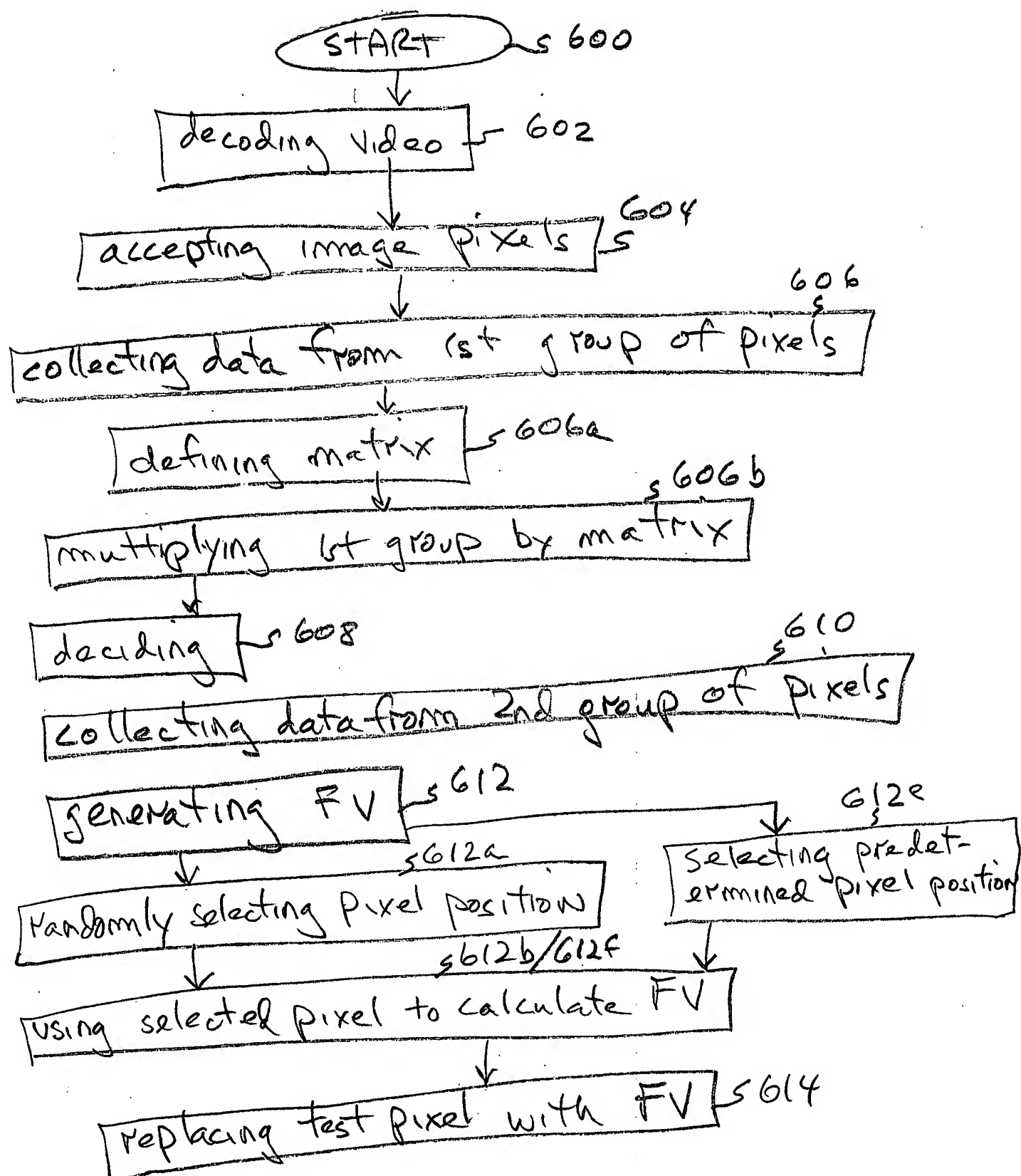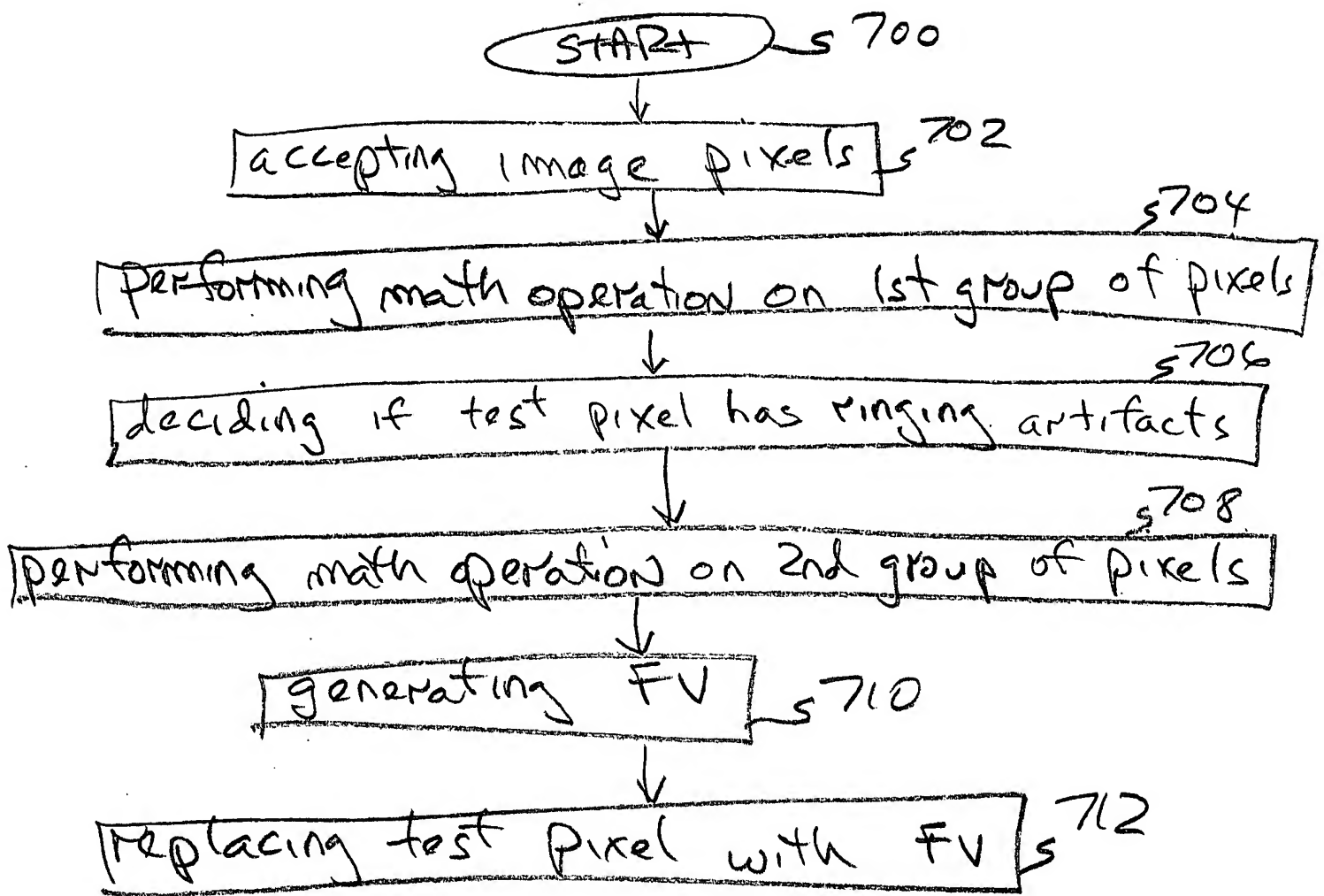
Fig. 4 Pseudo-code for de-ringing filter

```
                    ┌─────────────┐
                    │    Start    │
                    └─────────────┘
                           │
                           ▼
                    ╱─────────────╲
                   ╱     nE=0       ╲
                   ╲                ╱
                    ╲─────────────╱
                           │
                           ▼
              ┌─────────────────────────┐
              │ newVal=sum of current   │
              │  pixel's neighbors with a│
              │     Map value of 0      │
              │  nE=total neighbors with a│
              │     Map value of 0      │
              └─────────────────────────┘
                           │
                           ▼
                     ◇───────────◇        yes      ┌────────────────────────────┐
                    ╱  nE == 1    ╲─────────────────│ new pixel value for current pixel=│
                    ╲     ?       ╱                 │   (newVal+currentVal+1)>>1  │
                     ◇───────────◇                  └────────────────────────────┘
                           │                                     │
                           │ no                                  ▼
                           ▼                               ┌─────────┐
                     ◇───────────◇        yes              │   End   │
                    ╱  nE < 4     ╲─────────────┐          └─────────┘
                    ╲     ?       ╱             │    ┌────────────────────────────┐
                     ◇───────────◇              └────│ newVal=newVal+(4-nE)*currentVal│
                           │                         │ new pixel value for current pixel=│
                           │ no                      │   (newVal+2)>>2            │
                           ▼                         └────────────────────────────┘
                     ◇───────────◇                               │
                    ╱  nE < 8     ╲        yes                    ▼
                    ╲     ?       ╱─────────────┐           ┌─────────┐
                     ◇───────────◇              │           │   End   │
                           │                    │           └─────────┘
                           │ no                 │    ┌────────────────────────────┐
                           ▼                    └────│ newVal=newVal+(8-nE)*currentVal│
                     ◇───────────◇                   │ new pixel value for current pixel=│
                    ╱  nE == 8    ╲        yes        │   (newVal+4)>>3            │
                    ╲     ?       ╱─────────────┐     └────────────────────────────┘
                     ◇───────────◇              │               │
                           │                    │               ▼
                           │ no                 │          ┌─────────┐
                           ▼                    │          │   End   │
                     ┌─────────┐                │          └─────────┘
                     │   End   │                │   ┌────────────────────────────┐
                     └─────────┘                └───│ newVal=newVal-              │
                                                    │ graylevel(currentpixelx+1,currentpixely+1)+│
                                                    │        currentVal          │
                                                    │ new pixel value for current pixel=│
                                                    │   (newVal+4)>>3            │
                                                    └────────────────────────────┘
                                                              │
                                                              ▼
                                                         ┌─────────┐
                                                         │   End   │
                                                         └─────────┘
```

Fig. 5

START ⟵ 600

decoding video ⟵ 602

accepting image pixels ⟵ 604

collecting data from 1st group of pixels ⟵ 606

defining matrix ⟵ 606a

multiplying 1st group by matrix ⟵ 606b

deciding ⟵ 608

collecting data from 2nd group of pixels ⟵ 610

generating FV ⟵ 612

selecting predetermined pixel position ⟵ 612e

randomly selecting pixel position ⟵ 612a

using selected pixel to calculate FV ⟵ 612b/612f

replacing test pixel with FV ⟵ 614

Fig. 6

START $S700$

accepting image pixels $S702$

performing math operation on 1st group of pixels $S704$

deciding if test pixel has ringing artifacts $S706$

performing math operation on 2nd group of pixels $S708$

generating FV $S710$

replacing test pixel with FV $S712$

Fig. 7